CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

Central Valley Regional Water Quality Control Board

3 February 2016

Mr. Donald Ikemiya
Kaweah Basin Water Quality Association
P.O. Box 2840
Visalia, CA 93279

CONDITIONAL APPROVAL OF KAWEAH BASIN WATER QUALITY ASSOCIATION GROUNDWATER QUALITY ASSESSMENT REPORT

Thank you for the 7 February 2015 submittal of the Kaweah Basin Water Quality Association (Coalition) Groundwater Quality Assessment Report (GAR), as required by Waste Discharge Requirements General Order R5-2015-0120 (General Order). The purpose of the GAR is to provide the foundational information necessary for design of the Management Practice Evaluation Program, the Groundwater Quality Trend Monitoring Program, and the Groundwater Quality Management Plan(s).

As outlined in the enclosed staff review, the information provided generally addresses the General Order's main GAR objectives. However, additional data and information need to be collected, evaluated, and incorporated into the Coalition's conceptual hydrogeologic model as it moves forward with the evaluation and monitoring programs required under the General Order.

In order to facilitate implementation of the General Order's post-GAR groundwater requirements I am conditionally approving the Coalition's GAR. This conditional approval provides a pathway for the Coalition to address issues identified in the staff review through future work plans and the 5-year GAR update while also allowing the Coalition to expeditiously proceed with the important work of the Management Practice Evaluation Program, the Groundwater Quality Trend Monitoring Program, and the Groundwater Quality Management Plan(s).

If you have any questions, please contact Nicholas Smaira at (559) 488-4393 or by email at NicholasBassam.Smaira@waterboards.ca.gov.

Sincerely,

Clay L. Rodgers

for Pamela C. Creedon
Executive Officer

Enclosure(s) Table 1. Summary of Issues to be Addressed in Forthcoming Work Plans
Staff Review Memorandum

c: Sue McConnell, Central Valley Water Board, Rancho Cordova
Linda Sloan, Provost & Pritchard Consulting Group, Visalia

Table 1
Summary of Issues to be Addressed Forthcoming Work Plans*

Staff Memorandum Item	Groundwater Quality Management Plan(s) (Due as needed)	Groundwater Quality Trend Monitoring Program (Due 3 February 2017)	Groundwater Quality Assessment Report Update (Due 3 February 2021)
1.A		X	
1.B		X	
1.C			X
1.D		X	
1.E		X	
1.F		X	
2		X	
3.A	X	X	
3.B		X	
3.C		X	
3.D		X	
4	X	X	
6		X	
8.A	X	X	
8.B		X	
8.C		X	
9		X	
10		X	
11		X	
12.A		X	
12.B		X	
12.C		X	
12.D	X	X	
13		X	
15		X	
16.A		X	
16.B	X	X	
16.C	X	X	

* Once an item has been addressed through the designated work plan, the information and approach required to satisfy the item must be carried forward to all future reports.

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Central Valley Regional Water Quality Control Board

TO: David Sholes, CEG
Senior Engineering Geologist
Irrigated Lands Regulatory Program

FROM: Nicholas Smaira
Engineering Geologist
Irrigated Lands Regulatory Program

DATE: 3 February 2016

SUBJECT: REVIEW OF THE GROUNDWATER ASSESSMENT REPORT FOR THE KAWEAH BASIN WATER QUALITY ASSOCIATION

On 5 February 2015, Provost & Pritchard Consulting Group submitted a Groundwater Quality Assessment Report (GAR) on behalf of the Kaweah Basin Water Quality Association (Coalition or KBWQA). The GAR provides the foundational information necessary for design of the Management Practices Evaluation Program (MPEP), the Groundwater Quality Trend Monitoring Program (GQMP), and the Groundwater Quality Management Plan (GQMP). The GAR was reviewed to determine compliance with requirements pursuant to section VIII.D.1 of Waste Discharge Requirements General Order R5-2013-0120 (General Order), section IV.A of Attachment B (Monitoring and Reporting Program) to the General Order, and the Revising Order R5-2014-0143.

California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board or Water Board) staff's review of the GAR concluded that modifications and additions are necessary to the GAR to meet the terms and conditions of the General Order. Table 1 provides descriptions of the required GAR components from the General Order and Monitoring and Reporting Program and lists the section in the GAR that addresses each component. For incomplete items, recommended revisions/additions, if any, are provided below. The memorandum item numbers correspond to item numbers in Table 1.

Item 1. Assessment of Readily Available, Applicable and Relevant Data and Information to Determine High and Low Vulnerability Areas.

The General Order (Section VIII.D.1) requires that the GAR provide an assessment of all readily available, applicable and relevant data and information to determine the high and low vulnerability areas where discharges from irrigated lands may result in groundwater quality

degradation. While a portion of the available data was discussed in the GAR and referenced by the document, a large body of available information was not identified or evaluated. This has given rise to a variety of assumptions that have affected the interpretation of the water quality data present within and adjacent to the Coalition's boundaries. Recommended revisions include the following:

A. The GAR should be revised to include discussion regarding the effects of citrus production on groundwater quality within the Coalition's boundaries. The GAR failed to evaluate readily available publications that discuss the relationship between management practices and/or physical conditions on groundwater quality in citrus growing regions within the Coalition's area. These publications include, but are not limited to:

- The California Department of Food and Agriculture, Pest Management Analysis and Planning Program's PM 90-1 (Herbicide Use in Citrus Production and Ground Water Contamination in Tulare County). This report states in part that *"A substantial portion of all orchards, 67%, were planted on hardpan soil. To improve internal drainage and increase rooting depth, 46% of all growers have ripped their soil. Growers with hardpan were more likely to rip their soil than those without. The hardpan soils are located along the eastern foothills (Storey 1940, 1942)."*

  To reduce freeze damage in these citrus growing regions during the winter months, active frost protection measures are often necessary. The report identifies the most common method of frost protection in Tulare County to be a combination of wind machines and the application of irrigation water (45% of respondents). Additional, 19% of respondents relied only the application of irrigation water as their frost protection measure. The report goes on to state that *"If several nights of protection are necessary irrigation water may result in deep percolation of water and movement of herbicides below the zone of soil where herbicide degradation can occur and eventually movement down to ground water. Even short duration frost protection could have an affect since the soil is frequently saturated from winter rainfall."* The GAR should be revised to include a discussion regarding the reports findings.

- The California Department of Pesticide Regulation, Citrus Herbicide Mitigation Practices: Demonstration and Evaluation EH 03-01. This report identifies Fresno and Tulare counties as having the greatest number of confirmed preemergent herbicide detections in well water in California and discusses the role that surface water runoff to dry wells and other drainage structures has with regards to these detections. The information in this report needs to be evaluated and the GAR should be revised to include discussion regarding the threat to groundwater quality posed by direct transport of agricultural runoff to dry wells and other drainage structures.

- The Stone Corral Irrigation District's Five Year Update to their Agricultural Water Management Plan states in part that the district is currently in the process of evaluating the subsurface tile drainage system as a result of apparent water quality test results.

Although the GAR references this report and identifies that a tile drainage system is operated within Stone Corral Irrigation District, no information was provided regarding the water quality test results collected from the tile drainage system. As citrus production (oranges/tangerines) accounts for approximately 70% of the irrigated acres within the Stone Corral Irrigation District (based on cropping pattern information provided in the Five Year Update to their Agricultural Water Management Plan), data collected from the tile drainage system is relevant when evaluating the potential for discharges from citrus production to adversely impact groundwater quality. The GAR should be revised to include any water quality data collected from the tile drainage system.

B. The GAR should include a discussion of the Friant-Kern Canal and its role in providing surface water to area streams and irrigation canals or water for groundwater banking/recharge. Additionally, nitrate groundwater data from the irrigation districts Pump-in Program (wells discharging into the Friant-Kern Canal) should be obtained, evaluated and included in the GAR's discussion of the KBWQA area (Temporary Change in Water Quality Requirements for the Friant-Kern Canal Groundwater Pump-in Program, 2014, U.S. Department of the Interior Bureau of Reclamation, Draft Finding of No Significant Impact, October 2014, FONSI-14-043).

C. The discussion of regional geology in Section 2.2 of the GAR consists largely of content obtained from the Fugro West, Inc. report entitled Water Resource Investigation of the Kaweah Delta Water Conservation District (Fugro Report). This content included several references to published reports that were not included in the GARs list of references. All sources cited in the GAR should be included in Section 9: Bibliography/References of the GAR.

D. The groundwater discussions in Section 4 and Section 5 of the GAR should provide a clear and detailed description of the unconfined, semi-confined, and confined groundwater systems, where they exist within the KBWQA area, and the interactions between these systems. This section should also include further discussion regarding the difference in the depths of well completion that exists across the Coalition's area (completed both above and below the Corcoran Clay) and how the various depths of completion may affect groundwater quality (e.g.: wells that are completed in different aquifers [shallow unconfined, deeper semi-confined and deep confined aquifers] have different sediment/groundwater chemistries; various depths of wells produce different ages of groundwater; and that groundwater intercepted by the wells represents both distinct and diffuse recharge areas).

E. Section 5 of the GAR should also include a discussion/acknowledgement that well bores may provide potential preferential pathways for vertical migration between aquifers and how this may reflect on groundwater chemistry. As stated by a variety of USGS investigators (Lofgren and Klausing 1969, Williamson et al. 1987, Bertoldi et al. 1991, Burow et al. 2012), the high density of wells constructed with long perforated sections or multiple well screens provides vertical hydraulic connections within the aquifer system. The presence of tens of thousands of irrigation wells perforated at various levels (Harou and Lund 2008) has lead

USGS investigators and modelers to the concept of a single heterogeneous aquifer within the Central Valley with varying vertical leakage and confinement.

F. The groundwater quality discussion in Section 5 of the GAR identifies the multiple sources of groundwater data used by the Coalition to evaluate water quality within the KBWQA area; however, it does not provide the actual data set or identify a method for reproducing the data set used for GAR evaluations. Access to this data set is necessary for Central Valley Water Board staff review of the GAR and to determine if all the readily available data were evaluated. Based on the review of the reference section of the GAR, it appears that a number of relevant documents (some of which contain groundwater data that does not appear to have been included in the GAR data set) were not evaluated as part of the GAR (see Attachment B, Additional References to this memorandum).

Groundwater hydrology Section 4 of the GAR states in part that *"…well log research and comparison was not performed: however, reasonable assumptions and explorations were used for map preparations. The largest percentage of area was evaluated using vetted KDWCD data."*

Evaluating groundwater quality data without knowing the depth within the aquifer from which the sample was obtained provides an incomplete picture for purposes of assigning vulnerability. While some portion of the wells may not have construction information available, where such information is available it should be utilized in the evaluation of water quality data (e.g., well construction details should be compared to the depth to groundwater maps contained in the GAR and the historical maps presented on the California Department of Water Resources website to determine potential differences between shallow and deeper groundwater quality). Additionally, Table 7 of the Fugro Report states that *"Sufficient number of well logs (estimated to be in excess of 7,000) are available throughout the District and are believed to provide an excellent geographic distribution for all hydrologic units."* These well logs should be compared to the GAR data set.

Well construction in relation to the depth of first encountered groundwater is particularly important as it has been established by a variety of USGS investigators and academics that nitrate concentrations decline with depth below first encountered groundwater (Burow et al. 1998; Burow et al. 2012; Fuhrer et al. 1999, Rupert 1999). Therefore, areas for which only deep groundwater quality data are available cannot be assumed to be low vulnerability based solely on this data. Additional efforts need be made to obtain shallow groundwater quality data to comply with the requirements of the General Order (MRP Section IV. A. 2). A discussion should be developed regarding differences in shallow groundwater concentrations of constituents of concern (COC's) and deeper groundwater chemistry obtained from the same region. Any such discussion should be tied to an evaluation of the apparent age of the groundwater sampled by the USGS GAMA Wells, the depth to groundwater in these wells, and how this reflects on data interpretation.

Item 2. Establish Priorities for Implementation
The General Order (Section VIII.D.1) requires that the GAR establish priorities for the implementation of groundwater studies within high vulnerability areas. To meet the prioritization requirements of the General Order, the GAR assigned values based on proximity to a Disadvantaged Community (DAC) or small water system that is reliant on groundwater, intrinsic geologic conditions that play a significant part in groundwater vulnerability, and other contributing factors such as management practices and farm size. These values were then used to divide the high vulnerability area into three tiers, with tier 1 being the highest priority and tier 3 being the lowest priority. The GAR goes on to state that *"Tier 1 parcels will be the first areas required to comply with the WDRs"*.

All irrigated agricultural parcels must comply with the requirements of the General Order. While the GARs approach to identifying high priority regions within the high vulnerability areas appears appropriate, the proposed application does not comply with the requirements of the General Order. The GAR should be revised to specify that the tiered priority map will be used when implementing monitoring and studies within the high vulnerability areas.

Item 3. Basis for Establishing Monitoring Workplans Developed to Assess Groundwater Quality Trends
The General Order (Section VIII.D.1) requires that the GAR provide the basis for establishing workplans to assess groundwater quality trends. To address this requirement the GAR included information regarding the commodities grown in the KBWQA area, a process for prioritization (see Item 2 above), and information regarding the areas of groundwater recharge, groundwater contour maps and the locations of disadvantaged communities (see Item 8 below).

The GAR included an evaluation of nitrate and pesticide data collected within the last ten years, as well as a statistical assessment of some nitrate data to identify areas with statistically significant increasing trends (Theil-Sen). Several issues including data quality concerns, the appropriateness of the selected statistical method, and the function of the analysis as it relates to the designation of high vulnerability areas were identified during the review and are summarized below.

A. The GAR does not provide sufficient justification for the exclusion of data that was not collected within the last ten years. While focusing on recent data may be appropriate when conducting intra-well comparisons, all available data should be considered when assessing regional impacts from irrigated agriculture and evaluating tends. Excluding historical data may provide an incomplete assessment of water quality as mitigation measures are often taken when a well exceeds the maximum contaminant level (MCL) for a particular constituent. For example, if water quality data collected from a public water supply well prior to 2005 documented nitrate exceedances and the well was subsequently taken offline, data may not have been collected within the last ten years while nitrate impacts would likely still exist (see Item 16.B below). The GAR should be revised to evaluate all available water quality data.

B. The groundwater quality and trends discussion in Section 5.4 of the GAR states in part that *"To ensure that all of the available nitrogen concentration data was captured and not duplicated, the UCD* [University of Davis, California] *dataset was used for the calculations… While the data ends in 2010, the length of the dataset is sufficient for calculations. To be of sufficient quantity for analysis, only wells with at least eight detections within the monitoring record period were used."* As discussed in Item 1.F above, it is unclear if the data is of sufficient quality to support the statistical analysis performed since the GAR did not include the actual data set used or discuss how many wells in the UCD dataset wells meet the minimum criteria for trend analysis defined in the GAR.

The GAR states that the *"Theil-Sen analysis does not require normally-distributed data, can deal with some non-detect data points and is a recommended method of determining if statistically significant trends are found in the data set."* Theil-Sen trend analysis handles non-detect data points by assigning them a common value less than any other detected measurement. The GAR did not include the information necessary to demonstrate that the data set used for trend analysis included sufficient information regarding method detection and quantitation limits to deal with the non-detect data in this manner. In addition, large portions of non-detect data make computing the Theil-Sen tend line more difficult and uncertain since each non-detect is paired with a quantified measurement resulting in the pairwise slope to fall within a range of values. Further explanation regarding how non-detect data was managed and the extent of non-detect points within the data set is needed.

Figure 7-1 of the GAR provides a geographical representation of the areas identified as having a statistically significant increasing trend for nitrate. These areas were determined by comparing the wells identified as having an increasing trend with the Central Valley Hydrologic Model (CVHM) 1 mile grid system (e.g. an individual grid cell would be consider to be an area of increasing nitrate trends if it was overlaid by a well that was determined to have an increasing trend). This approach resulted in the identification of 32 CVHM grid cells having increasing trends. Of these 32 CVHM grid cells, 11 are entirely surrounded by areas not identified as having increasing trends, while the remaining 21 CVHM grid cells are surrounded by no more than two CVHM grid cells that are identified as having increasing trends. This approach created a checkerboard pattern that does not appear to have considered the area specific hydrogeology and is likely a result of limited data. The GAR should be revised to provide a geologic interpretation of trend analysis results.

C. The GAR only evaluated pesticides with a numeric MCL, however an MCL or other water quality criteria has not been established for a large number of the pesticides (or their associated transformation products) applied within the Coalition's area. This approach of only evaluating pesticides with a MCL does not account for the possible cumulative effects on water quality if multiple pesticides are present in groundwater. Central Valley Water Board's *Water Quality Control Plan for the Tulare Lake Basin* (Basin Plan) states that no individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. While the detection of a pesticide below its respective MCL or the detection of a pesticide without a numeric MCL may not merit a high vulnerability

designation, at a minimum the GAR should evaluate this data in parallel with the other water quality and hydrogeologic data.

D. Section 5.3.3 of the GAR states in part that *"Salinity in water supplies can originate from natural sources, sewage, runoff and deep percolation from urban and agricultural areas, industrial wastewater, and oilfield production water. Complex hydrogeologic processes often dissolve, transport, dilute, concentrate and/or precipitate salts. Variations in surface water availability affect recharge with high quality surface water and subsequent salt dilution of salts. Once maps were prepared for the three constituents of focus* [nitrate, pesticides, and salinity]*, it was determined that mapped EC/TDS* [electrical conductivity/total dissolved solids] *exceedances were redundant to the nitrate/pesticide issues and not necessarily indicative of potential groundwater impacts due to irrigated agriculture within the KBWQA area"*

While there are many sources of salt within the Coalition's area, the General Order only requires that the GAR assess the influence of irrigated agricultural activities on salinity trends. These agricultural activities include, but are not limited to, the importation of salts in irrigation water, the accumulation of salts in the soil due to evapotranspiration and subsequent leaching of these accumulated salts below the crops root zone, the application of nutrient salts added as fertilizers, and the use of soil amendments. The GAR should be revised to discuss the various agricultural activities related to the importation and/or concentration of salts that may adversely impact groundwater quality. Although the GAR concluded that the salinity analysis was redundant, staff is unable to review this finding as the analysis was not included. The GAR should be revised to include an evaluation of the EC/TDS data.

Item 4. Basis for Establishing Management Practices Evaluation Program (MPEP) Workplans.

While Section 6 of the GAR includes discussion regarding the general objectives of the MPEP and information regarding existing groundwater monitoring programs, it does not provide any details specifically related to the establishment of the MPEP. The GAR states in part that *"Any groundwater quality monitoring that is part of the MPEP workplan must be of first encountered groundwater. Thus, the MPEP may be limited with regards to the kinds of existing groundwater monitoring programs that can be incorporated as part of the workplan."*

While some sources of shallow groundwater data were identified, the GAR did not provide an assessment of these monitoring well networks or discuss their potential for use in the MPEP. For example, the GAR identifies the Visalia Landfill as a regulated facility with a shallow groundwater monitoring well network within the Coalition boundaries. The GAR however does not include an evaluation of the data associated with the landfill. The Visalia Landfill is bordered by both KBWQA members and dairy facilities/land application fields. In April of 2015, groundwater data collected from this monitoring well network detected nitrate concentrations above the MCL in 15 of the 19 wells sampled.

The GAR should be revised to identify geographically where first encountered groundwater data are available and evaluate these data for evidence of discharges of waste from irrigated lands. Areas and/or crop types where shallow groundwater quality appears to have been adversely impacted by agricultural operations will be subject to MPEP work plan development either solely by the Coalition, or as a coordinated group effort.

Item 6. Land Use and Management Practices Information.
Section IV.A.2 of the Monitoring and Reporting Program requires that the GAR include detailed land use information for the Coalitions area and identify the largest acreage commodity types (including the most prevalent commodities comprising up to at least 80% of the Coalitions irrigated agricultural acreage). Section 3 of the GAR includes an assessment of the available land use data sets, crop maps produced using 2007 data from the California Department of Water Resources (DWR) and 2013 data from the Tulare County Agricultural Commission, and tables identifying the largest acreage commodity types within the Coalition's area.

Section 3.1.4 of the GAR states in part that although the United States Department of Agriculture (USDA) cropland data layer contains more recent land use information, the 2007 DWR data set was used because it had a greater level of quality control. Based on data collected from USDA's National Agricultural Statistics Service, cropping patterns within Tulare County have significantly changed since 2007. For example, since 2007 the acreage of both pistachios and almonds harvested within Tulare County has more than doubled while the acres harvested of tangerines and mandarins have more than quadrupled. Alternately, a significant reduction in harvested acres of silage and alfalfa were reported between 2007 and 2014. Although the DWR land use data may have greater quality control measures than the USDA cropland data layer, the difference in harvested acres between 2007 and 2014 suggests that the more recent USDA cropland data layer more closely reflects current land use. Staff recommends that the GAR be revised to include the review and use the USDA cropland data layer.

Item 8. Groundwater Recharge
Section IV.A.2 of the Monitoring and Reporting Program requires that the GAR include information regarding groundwater recharge within the Coalition area, including the identification of areas contributing recharge to urban and rural communities where groundwater serves as a significant source of supply. Although Section 4.5 of the GAR did include some information on the groundwater recharge, review of this material has identified issues (detailed below) and additional information is needed. The GAR should be revised to address these issues and provide the necessary additional information.

A. The GAR should provide specific information regarding how groundwater recharge is related to the depth to groundwater maps, water surface elevation maps, and the vertical conductivity and potential recharge areas map. While the GAR includes a cursory review of the average vertical conductivity and depth to groundwater, it does not provide the detailed evaluation necessary to identify areas that contribute recharge to urban and rural communities within the Coalition's area where groundwater serves as a significant source of

supply. For example, the disadvantaged unincorporated community Ivanhoe is situated down-gradient of a northeast-southwest groundwater ridge that appears to be produced by recharge from the St. Johns and Kaweah rivers south of town. A groundwater depression occurs northwest of town. Recharge to Ivanhoe groundwater wells is likely from the southeast of town. Recent sampling (February 2015 and March 2015) of Ivanhoe supplies wells document four supply wells that exceed the MCL for nitrate and one well containing nitrate concentrations greater than half the MCL.

B. The GAR discussion regarding sources of recharge states in part that *"only waterways that are clearly a natural channel or retained some natural attributes were included…Tiny, straight, clean channels with smooth regular edges and no connections to recharge ponds and apparent dairy lagoons or ponds that would likely be lined (small artificial lakes surrounded by houses) were not included."* This approach of assessing sources of recharge within the Coalition's area is inappropriate provided that the 2010 Initial Agricultural Water Management Plan for the Kaweah Delta Water Conservation District indicates that groundwater recharge from irrigation ditches (161,718 acre feet [AF]) is more than twice the volume recharged by natural channels (74,929 AF). In addition, the 2010 Initial Agricultural Water Management Plan specifies that 149,000 AF of recharge is attributed to percolation from basins. The GAR did not include location information or an evaluation of recharge from basins within the Coalition's area. The GAR needs to be revised to evaluate the role irrigation ditches and basins have on groundwater recharge and clearly identify the location of these recharge sources within the Coalition's area.

C. The GAR does not acknowledge irrigation as a source of groundwater recharge. Diffuse recharge from surface applied water can be a significant source of aquifer recharge and the GAR should be revised to include discussion regarding the significance of irrigation on groundwater recharge.

Item 9. Soil Survey Information

Section 2.3 of the GAR provides a discussion of soil proprieties and their importance in the design and management of irrigation systems but does not include an interpretation for how these soil proprieties affect the potential for groundwater impacts from irrigated agriculture. For example, the soil chemistry discussion in Section 2.3.1.2 of the GAR describes how high concentrations of salts may interfere with the absorption of water by plants or interfere with the exchange capacity of nutrient ions. However, the GAR did not evaluate potential impacts to water quality from agricultural activities in areas with high salinity soils. The GAR should be revised to include an evaluation of soil proprieties as they relate to potential impacts to groundwater quality.

Item 10. Shallow Groundwater Constituent Concentrations from Existing Monitoring Networks

Section IV.A.2 of the Monitoring and Reporting Program requires that the GAR include information and data on shallow groundwater constituent concentrations that could be related to agricultural activities. As discussed in Item 4 above, the GAR identifies some existing shallow

groundwater networks but does not include an evaluation of the existing data. Additionally, the GAR only evaluates nitrates (see Item 3.A above), salinity (see Item 3.D above), and pesticides that are monitored by the California Department of Pesticide Regulation (DPR) and have a MCL (see Item 3.C above).

The pesticide exceedance map included as Figure 5-2 of the GAR identifies each CVHM grid cell within the Coalition's area that underlies a well that has documented an exceedance for a pesticide within the last ten years. However the figure does not indicate what pesticide(s) was detected, the number of exceedances within the CVHM grid cells, or if there are multiple wells with exceedances. It does not appear that all readily available data and information regarding pesticides detections in shallow groundwater were used to identify the areas outlined in Figure 5-2 of the GAR. The GAR should be revised evaluate all available pesticide data to identify constituents of concern and provide additional discussion regarding the occurrence/detections of pesticides in groundwater.

Item 11. Information on Existing Groundwater Data Collection and Analysis Efforts
The groundwater data compilation and review must include all readily accessible information relevant to the Order on existing monitoring well networks, individual well details, and monitored parameters. For existing monitoring networks (or portions thereof) and/or relevant data sets, the Coalition should assess the possibility of data sharing between the data-collecting entity, the Coalition, and the Central Valley Water Board.

Section 6 of the GAR includes discussion on existing groundwater monitoring programs within the Coalition's area and identified the following entities that have historically conducted and/or currently conduct groundwater monitoring; California Department of Water Resources (DWR), California Department of Pesticide Regulation, State Water Resource Control Board's Division of Drinking Water Program (DDW), Kaweah Delta Water Conservation District, Tulare Irrigation District, and various monitoring well networks associated with facilities permitted under Waste Discharge Requirements issued by the Central Valley Water Board. While the GAR provides an overview of these efforts and their monitoring networks, sufficient information was not provided to evaluate the possibility of data sharing. The GAR should be revised to include (when available) individual well construction details, identification of the constituents analyzed, quality assurance and quality control (QA/QC) used to validate the data, and specify which data sets correspond to specific or general geographical areas within the Coalition's boundaries.

Item 12. Existing Water Quality Impacts and Vulnerable Conditions
Section IV.A.3 of the Monitoring and Reporting Program requires that the GAR identify known groundwater quality impacts for which irrigated agricultural operations are a potential contributor or where conditions make groundwater more vulnerable to impacts from irrigated agricultural activities. Review of the GAR has identified the following concerns regarding existing groundwater quality impacts and data/information not included. The GAR should be revised to address these concerns.

A. As described above (see Items 1.A, 1.B, 1.F, 3.A, 3.C, and 3.D), additional readily available data exist that has not been evaluated by the GAR. These data need to be reviewed and the GAR updated to reflect the results of the new information.

B. The GAR provided data on soil type, depth to groundwater, crop types, irrigation methods, nutrient/pesticide application methods, and a portion of COCs detected by groundwater monitoring; however, it did not provide an evaluation of this data with respect to potential impacts from irrigated agricultural operations (e.g., high pesticide levels in citrus growing areas).

   Braun and Hawkins (1991) conducted a rainfall runoff monitoring study in a citrus- growing region of Tulare County, California. This study identified that some growers within areas underlain by shallow hard-pan soil layers were disposing of excess surface water runoff using dry wells. Relatively high concentrations of diuron in runoff-water entering dry wells were found, ranging up to 890 micrograms per Liter (µg/L). Braun and Hawkins (1991) concluded that "the data provide strong evidence that the widespread regional presence of diuron in ground water is at least partially attributable to contaminated runoff water entering dry wells."

C. The primary focus of groundwater quality, with regards to determining vulnerability for irrigated agriculture operations, was on nitrate and pesticides with a numeric MCL. The Order requires that the GAR address all constituents of concern associated with agriculture. At a minimum, the High Vulnerable Areas (HVAs) should be evaluated for areas with high salinity.

D. If any readily available nitrite data are available in the data sets utilized by the GAR, this information should also be evaluated relative to the nitrite MCL (2 mg/l).

Item 13. Feasibility of Incorporating Existing Groundwater Data and Their Corresponding Monitoring Well Systems.

The GAR states in part that "*Both the deeper and RWQCB-supervised well networks are potentially suitable for future trend monitoring pending available well construction data, accurate well location, and the ability to constituent provenance. The shallow well network will not be sufficient to monitor the entire area, but with the impacts to the deeper groundwater, a deeper well network may be more appropriate.*"

While the GAR includes a cursory review of the existing groundwater monitoring well networks (see Items 1.F, 4, and 11 above), it did not include sufficient detail or analysis of the available information to identify if these monitoring well networks could be incorporated into the groundwater monitoring programs required by the General Order. Additionally, Section IV.C.2 of the Monitoring and Reporting Program states that groundwater quality trend monitoring needs to employ shallow wells, but not necessarily wells completed in the uppermost zone of first encountered groundwater. The GAR should be revised to evaluate the available information as it relates to the feasibility of incorporating existing wells into the monitoring programs required

by the General Order and specify that the trend monitoring program will utilize shallow wells when available as required by the Monitoring and Reporting Program.

Item 15. Describe pertinent geologic and hydrogeologic information for the third-party area(s) and utilize GIS mapping applications

The GAR should be revised to include additional discussion of the regional geology and hydrogeology (see Items 1.C, 1.D and 1.F above). Additionally, the scale/size of the maps provided in the GAR make the review of the figures difficult. The GAR maps either should be enlarged or the Coalition should provide all pertinent shapefiles so that Central Valley Water Board staff can review the figures.

Item 16.Groundwater Vulnerability Designations

The General Order requires that the GAR designate high/low vulnerability areas for groundwater where known groundwater quality impacts exist for which irrigated agricultural operations are a potential contributor or where conditions make groundwater more vulnerable to impacts from irrigated agricultural activities. The vulnerability designations are to be made using a combination of physical proprieties (soil type, depth to groundwater, known agricultural impacts to beneficial uses, etc.) and management practices (irrigation method, crop type, nitrogen application and removal rates, etc.). Review of the vulnerability analysis Section 7 of the GAR has identified the following concerns that need to be addressed.

A. The vulnerability designations proposed in the GAR were determined by overlaying the following elements on a map; CVHM grid cells that contain a well with documented nitrate and/or pesticide exceedances within the last ten years (see Item 3.A, 3.C and 3.D above), CVHM grids cells that contain a well with statistically significant up-trending nitrate detections (see Item 3.B above), disadvantaged communities and small water systems that are reliant on groundwater, and groundwater elevation data from spring 2014. The GAR goes on to state that spatial gaps were then assessed for exclusion from the HVAs based on; the last ten years of groundwater quality data indicating a lack of groundwater impacts from nitrate or pesticides, endangered species critical habitat, or residential or industrial land use, or other non-agricultural land uses.

   The method for designating HVAs does not meet the minimum requirements specified in Section IV.A.4 of the Monitoring and Reporting Program. Specifically, the proposed method does not include an evaluation of all the relevant hydrogeologic factors that contribute to intrinsic vulnerability (e.g. hydraulic conductivity, porosity, presences or absence of confining zones, presences or absence of preferential pathways, thickness of the vadose zone, etc.). While the vulnerability assessment does appear to utilize groundwater elevation data, it is unclear how these data were used to determine the HVAs.

B. It is unclear why the residential properties located at the south east corner of Clinton Avenue and Road 96 (just south of Tulare) are designated as high vulnerability while the agricultural properties surrounding the area are not. Review of the most recent Geotracker GAMA data for the nearby water supply well (April 2000) documented nitrate at concentrations

exceeding the MCL. The agricultural lands surrounding these homes should be designated as high vulnerability unless additional information is provided to document that the condition of pollution no longer exists and that the hydrogeology is such that the area would not be considered intrinsically susceptible to impacts from irrigated agricultural activities.

C. Although the vulnerability assessment included areas identified as having a statistically significant increasing nitrate trends, sufficient information was not included to evaluate how this information was applied. At a minimum, high vulnerability needs to include all areas where nitrate and EC concentrations in groundwater are at 50% of the MCL or higher and have a trend indicating a statistically significant increasing concentration.

Table 1. Components of the Groundwater Assessment Report

Item No.	Required Component	Location in GAR
GAR Objectives – MRP section		
1	Provide an assessment of all readily available, applicable and relevant data and information to determine the high and low vulnerability areas where discharges from irrigated lands may result in groundwater quality degradation.	Partial Sections 5, 7 Throughout
2	Establish priorities for implementation of monitoring and studies within high vulnerability or data gap areas.	Section 7
3	Provide a basis for establishing Monitoring Workplans developed to assess groundwater quality trends.	Partial Sections 2, 4, 5
4	Provide a basis for establishing Management Practices Evaluation Program (MPEP) Workplans and priorities developed to evaluate the effectiveness of agricultural management practices to protect groundwater quality.	Partial Throughout
5	Provide a basis for establishing groundwater quality management plans in high vulnerability areas and priorities for implementation of those plans.	Throughout
Required GAR Components – MRP section		
6	Detailed land use information with emphasis on land uses associated with irrigated agricultural operations. The information shall identify the largest acreage commodity types in the third-party area, including the most prevalent commodities comprising up to at least 80% of the irrigated agricultural acreage in the third-party area. If the third-party manages the area through sub-watershed groups, the GAR information should be developed for each sub-watershed.	Partial Section 3
7	Information regarding depth to groundwater, provided as a contour map(s), if readily available. Tabulated and/or graphical data from discrete sampling events may be submitted if limited data precludes producing a contour map.	Section 4
8	Groundwater recharge information, if readily available, including identification of areas contributing recharge to urban and rural communities where groundwater serves as a significant source of supply.	Partial Section 4
9	Soil survey information, including significant areas of high salinity, alkalinity and acidity.	Partial Section 2
10	Shallow groundwater constituent concentrations from existing monitoring networks (potential constituents of concern include any material applied as part of the agricultural operation, including constituents in irrigation supply water [e.g., pesticides, fertilizers, soil amendments, etc.] that could impact beneficial uses or cause degradation).	Partial Section 5
11	Information on existing groundwater data collection and analysis efforts relevant to this Order (e.g., Department of Pesticide Regulation [DPR], United States Geological Survey [USGS], State Water Board Groundwater Ambient Monitoring and Assessment [GAMA], California Department of Public Health, local groundwater management plans, etc.). This groundwater data compilation and review shall include all readily accessible information relevant to the Order on existing monitoring well networks, individual well details, and monitored parameters. For existing monitoring networks (or portions thereof) and/or relevant data sets, the third-party should assess the possibility of data sharing between the data-collecting entity, the third-party, and the Central Valley Water Board.	Partial Section 6

GAR Data Review and Analysis – MRP section		
12	Determine where known groundwater quality impacts exist for which irrigated agricultural operations are a potential contributor or where conditions make groundwater more vulnerable to impacts from irrigated agricultural activities.	Partial Section 5
13	Determine the merit and feasibility of incorporating existing groundwater data collection efforts, and their corresponding monitoring well systems for obtaining appropriate groundwater quality information to achieve the objectives of and support groundwater monitoring activities under this Order. This shall include specific findings and conclusions and provide the rationale for conclusions.	Partial Section 6
14	Prepare a ranking of high vulnerability areas to provide a basis for prioritization of work plan activities.	Section 7
15	Describe pertinent geologic and hydrogeologic information for the third-party area(s) and utilize GIS mapping applications, graphics, and tables, as appropriate, in order to clearly convey pertinent data, support data analysis, and show results.	Partial Throughout
Groundwater Vulnerability Designations – MRP section		
16	The GAR shall designate high/low vulnerability areas for groundwater in consideration of high and low vulnerability definitions provided in Attachment E of the Order. The vulnerability designations will be made using a combination of physical properties (soil type, depth to groundwater, known agricultural impacts to beneficial uses, etc.) and management practices (e.g., irrigation method, crop type, nitrogen application and removal rates, extent of implementation, etc.). The third-party shall provide the rationale for proposed vulnerability determinations.	Partial Section 7
Other		
17	Section 7835 of the California Geologist and Geophysicist Act states that **"**All geologic plans, specifications, reports, or documents shall be prepared by a professional geologist or registered certified specialty geologist, or by a subordinate employee under his or her direction. In addition, they shall be signed by the professional geologist or registered certified specialty geologist or stamped with his or her seal, either of which shall indicate his or her responsibility for them."	Included

Attachment B
Additional References

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